DOCUMENT RESUME

ED 180 442 IR 007 916

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TITLE Self-Paced Instruction in SPSS with Multitutor.
PUB DATE 6 Apr 79
NOTE 12p.: Paper presented at the Annual Conference on Academic Computing Applications (Gary, IN, April 6, 1979): For a related document, see IR 007 915
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EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Computer Assisted Instruction: Computer Programs: *Individualized Instruction: Instructional Aids: Instructional Programs: *Learning Modules: *Mastery Learning

ABSTRACT

More than a dozen CAI modules which teach the uninitiated user how to use the interactive Statistical Package for the Social Sciences (SPSS) are described. The modules are based on the principle of incrementally increasing difficulty, self pacing, and student involvement. The first half of the set introduces the student to interactive computing, illustrates required SPSS control cards, and enables the student to get an output from a small data file which s/he has created. The modules conclude with the student being led through a series of analyses involving 1976 U.S. socio-economic, attitudinal, and voting data. The modules are written in Multitutor for CDC's interactive SPSS, but they can be adapted especially to PLATO and, with greater effort, to IIS or Coursewriter. (Author)

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SELF-PACED INSTRUCTION IN SPSS WITH MULTITUTOR

by

Jeffrey W. Wides

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SELF-PACED INSTRUCTION IN SPSS WITH MULTITUTOR

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INTRODUCTION

Over the past two or three years the Statistical Package for the Social Sciences has been increasingly utilized at my own University--in undergraduate and graduate courses across several different Schools, for most theses employing statistical analyses and by faculty research. Empirical data and impressionistic conversations indicate that the same thing is happening not only in other universities but also in other computer installations of various types throughout the country.

Yet it has been my repeated experience to realize that most potential statistical users of the computer are both ignorant and scared. Ignorant even of the existence of such statistical packages as SPSS, let alone the basic potentials of its use and the basic mechanics of using it. But fear is perhaps the greater problem, for using SPSS involves a computer, learning something new and using numbers. While those of you who are computer experts may laugh, the fact is that those who have never used a computer often appear paralyzed. This of course creates difficulties for them. On a personal level I would list those difficulties as including a sense of inadequacy, inferiority and failure, an over-dependence on others and wasting one's energy through spinning wheels. On a professional level I would list those difficulties as including falling behind in knowledge, poorer work and inability to complete otherwise reachable goals.

But I do not want to pretend that I am concerned about only THEM. As my University's chief consultant for statistical data processing applications, I neither enjoy nor benefit from dealing with people who are wholly ignorant of statistical packages and paralyzed with fear. Oh to make them less ignorant and less fearful, more independent and more confident! And, I will add, more literate. The manual(s), lectures(s) and workshop(s) are solutions that come to mind, and they are solutions which have been tried--with limited success.

Beginning in February 1978 I began work on another solution-- a series of interactive computer modules intended to teach the novice how to use SPSS. The phenomenon is usually called Computer Assisted Instruction (CAI), and it is intended to enhance the learning process through more effective use of faculty, student and equipment resources. CAI can take many forms, including games, simulations, drill and practice, testing, student inquiry and tutorials. At its best, CAI individualizes instruction according to the student's needs, give the student meaningful control over the learning process, and determines and provides necessary remediation. My lessons are tutorials. They consist of textual materials, review questions, branching routines which are guided sometimes by answers to test-review questions and other items by simple student preference and, finally, actual SPSS runs.

SPI AS AN INSTRUCTIONAL APPROACH

These days we are confronted with a plethora of initials and acronyms, and the computer industry is probably as responsible for the situation as any. To take just this Conference, for example, we are bombarded with, among other letters, CAI, CMI, and CBE. One would think that enough is enough. The idea is appealing, but alas, untrue, for this paper uses still another term. The SPI of "SPI for SPSS" stands for self-paced instruction. We will attempt to explain how the principle of self-paced instruction has been used in the development of a set of interactive teaching modules which are intended to enable the uninitiated to become an independent user of SPSS.[1]

SPI is similar to but in many important respects different from the better known PSI, Keller's Personalized System of Instruction.[2] We can explain the Keller Plan as one which individualizes instruction through allowing the student to control the learning pace, requires unit mastery before proceeding, uses the classroom as a secondary rather than primary teaching medium, stresses written teacher-student communication, and utilizes proctors for grading and tutoring. The Plan includes well-defined objectives for each unit, frequent testing and feedback, and human interaction. Most of the research comparing variates of the Keller Plan with variates of the lecture-discussion method of teaching have shown the former to produce superior academic achievement and retention as well as more positive attitudes toward the learning process.[3]

The main difference between SPI and PSI are the facts that the computer replaces the proctor for tutorial purposes and that the notion of student pacing is more strongly emphasized. The ideas of unitized materials, well-defined objectives, written communication and frequent testing and feedback remain the same. Although unit mastery is not required before a student is allowed to proceed through the SPI for SPSS modules, failure to master earlier material will in fact lead to incomprehension of later modules. This will necessitate retaking the previous materials until they are mastered.

SELF-PACING

As self-pacing may mean different things to different people, I want to clarify how the term is being used. It is being used in the sense that the student has significant control over important aspects of the speed with which s/he is presented with and expected to absorb the learning materials. It does not mean that the learning process is under the total control of the student. That would run the risk of procrastination and no acquisition of skills and understanding.[4] It is expected that such tendencies would be offset by instructors establishing deadlines for assignments and of course the incentive of better grades for assignment completion.

Beginning with a self-evident point, the student controls his/her learning pace through controlling the carriage return. Students can thereby do anything from skimming the materials to carefully reading them several times before asking for more.

The student, interacting with the computer, also controls his/her learning pace through answers to the multiple-choice questions which are asked throughout. This is done in several ways. A wrong answer is sometimes used to pinpoint a problem and clarify the misunderstanding which the answer has denoted. An answer occasionally leads to the student's being taken back to an earlier lesson which has been improperly understood or an earlier assignment which has not been completed. The number of correct answers to a series of questions can determine whether the student is taken to a review unit within a module or allowed to continue his/her linear progress through the module.

A related topic of self-pacing is the student's frequent option to skip non-essential segments of a module. In the first module, for example, s/he may forego more details about logging on, and the student interested only in interactive mode may opt not to take the sections concerned with batch mode. Similarly, a mini-lecture about statistical choice may be ignored.

The learner, furthermore, has choices of reviewing a particular unit or units of a module, thereby controlling the number of times s/he is exposed to the material. Faster learners will not have to review, and slower learners are able to proceed at a private pace consistent with their needs. And as stated above, people who have inadequate mastery of the early modules will be forced by their inability to comprehend later ones to retake early lessons in their entirety.

When a particular module becomes too difficult or boring, the student is given ways to immediately exiting the lesson. On the other hand, when the material is rather easy, the study has opportunity to take two or more lessons in a row before logging off the terminal.

A less obvious but more important way self-paced instruction is implemented in the modules is that the student often controls the order of presentation. The facts that certain segments of the modules can be skipped and that the student has control of what (if anything) is to be reviewed have already been mentioned. Another example would be the module which discusses batch SPSS, where the student is given the choice of initially studying either the necessary program commands or the necessary system commands. Again, the student does not have total control, for the author assures that the basics are covered, and covered incrementally. But where the order of presentation is not essential to the learning process, authority is turned over to the student.

Perhaps the most important way a combination of author-paced and self-paced instruction is reflected by the modules is the principle of incrementally increasing difficulty. Beyond that, the early modules use a stimulus-response approach with maximum possible re-enforcement, whereas the later modules increasingly emphasize student initiative and independence. As the student obtains the actual outputs of frequencies tables, cross-tabulations, product-moment correlations, partial correlation, analysis of variance, regression, and discriminant analysis runs, substantive and theoretical implications are discussed and, most importantly, questions for additional thought and analyses are suggested. The student is steadily given an increasing amount of ability, freedom and encouragement to perform his/her own data analyses. This can be done not only within the modules but also independently of the modules through using the SPSS system file to which the modules are linked. The modules are thus intended to lead

the student, at his/her own pace, from a state of relatively passive learning to a state of relatively active inquiry.[5]

The extent to which s/he can carry this inquiry is far-reaching. Having begun with questions suggested but no examined in the modules, the student can use the same data base to examine research questions not even suggested in the text. Less than half of the 26 variables which constitute the illustrative data base are seriously considered in the modules themselves. Similarly, the student is free to go to the pages referenced in the SPSS manual for more details about most topics covered in the modules. It all depends on his/her interests and abilities, and the requirements of the instructor.

Having learned a set of basics about his/her terminal, the system's files and commands, SPSS's data definition, transformation and selection statements, an SPSS sytem file, and, most importantly, performed and interpreted a variety of statistical tasks, the student should come away as a self-sufficient user of SPSS. If the intended results are achieved, and preliminary evidence indicates that this is so, the SPI for SPSS modules will have taught a useful societal skill in an individualized manner. In other words, they will have given the novice some familiarity with computers and some skills in statistical analysis, and they will have done so at a pace with which his/her ability and personality are comfortable.

IMPLEMENTATION

Before specifically illustrating some of those lessons, I will say just a few words about the language in which they are written and the network on which they are stored. The language is MULTITUTOR, a computer based educational approach which was originally developed at Northwestern University and has since been installed at other computer systems throughout the country. The version used for the SPSS lessons includes modifications from Northwestern, Indiana University, the University of Georgia, and the Mid-Illinois Computer Cooperative.

MULTITUTOR utilizes many features of the PLATO IV language, Tutor, but requires only conventional terminals to author and execute CAI lessons. MULTITUTOR is capable of creating and updating CAI lessons, storing student responses, issuing responses contingent on user input, and branching according to a wide variety of user and author-controlled criteria.

MULTITUTOR has the capability both to link the CAI lesson to all or parts of another and to link a CAI lesson to other languages and programs on the system. For example, within MULTITUTOR the user can be led from a MULTITUTOR lesson to a Fortran program and back again to the CAI lesson.

The lessons have been written on a Control Data Corporation Cyber 72-14, which is the central processing unit of an organization called the Mi-Illinois Computer Cooperative. MICC was formed in 1974, and is now comprised of ten state universities throughout Illinois (not including the U. of I.), each of which can lease to other institutions. The schools are connected to

the central site through a network of telephone lines and remote terminals, with most of processing being interactive.

CONTENT

As said above, they are primarily directed at the novice. One of their guiding principles is competency-based instruction, i.e. to instruct the student at a level with which his/her competency is comfortable. As you can see from the outline, they begin at an elementary level. The organization is such as to reflect linearly increasing difficulty. Each later module covers a slightly more difficult topic(s) than the preceeding one, and successful completion of each is dependent on successful completion of earlier modules.

This paper will conclude, albeit anti-climatically, with a brief description of the substantive content of the 12 modules. TS1 is simply a general introduction to interactive terminals, the computer, and overcoming one's anxieties about dealing with such machines. TS2 introduces the student to the Mid-Illinois Computer Cooperative, discussing important distinctions among three categories of files and two categories of commands and finally illustrating the use of specific system commands. (TS2A can be taken as a short-cut to reviewing particular sections of TS2.) Still discussing the system per se, TS3 instructs the student increating and storing data files, both interactively and through card reader. The student is also assigned the task for creating his/her own small data file.

The discussion of SPSS begins in TS4, where required data definition statements are presented and the student is taught how to do a small run on his/her previously created file. TS5 introduces some more sophistication and flexibility to required data definition statements, introduces a way of getting statistics from SPSS, and explains how procedural files can be kep for later use.

Although the modules concentrate primarily on SPSS on-line, TS6 is devoted to a presentation of batch SPSS. Here the necessary cards for doing an SPSS run via the card reader are presented, and the minor differences between interactive and batch program commands are illustrated.

The gloves begin to come off in TS7, where the student is presented with a Codebook of our illustrative data file, a DATA LIST statement is detailed, and the handling of missing data is discussed. The data used in modules seven through 12, by the way, are taken from the Center for Political Studies' 1976 National Election Study.

TS8 discusses and illustrates additional optional data definition statements, explains what an SPSS system file is, and takes the student through the process of creating one. In TS9 the student obtains his/her own frequency distributions and cross-tabulations, is given the opportunity to read a mini-lecture on statistical choice, is exposed to a method of reducing response time through sampling the data, and is introduced to data transformation statements. (TS9A can be taken as a short-cut to the mini-lecture.)

TABLE: 1 SPI for SPSS Modules Outline

TS1 INTRODUCTION

Logging In
What a Computer Is
Carriage Return
User Anxieties
Machine Problems
Erasing
More than One Way

TS2 THE SYSTEM

Three Categories of Files
Two Categories of Commands
Important System Commands
Save, Define, Get
Attach, Return, Purge

TS3 CREATING A DATA FILE

Interactively
Corrections
Batch
Student Assignment

TS4 REQUIRED DATA DEFINITION

Variable List
N of Cases
Input Format
Frequencies Task
Interactive Line Numbering
Frequencies Assignment

TS5 MORE TS4

Names
To Convention
Integer Mode
Statistics
(Input Medium, Read Input Data, Finish)
Data List
More Lines
Swrite and Sread

TS6 BATCH SPSS

System Commands
Program Commands

TS7 OUR DATA

Codebook
Data List
Missing Values

TS8 OUR SPSS SYSTEM FILE

Var Labels
Value Labels
A System File
Creating It
Living in a Computer

TS9 FIRST ANALYSES

Frequencies
Sample
Recode
Crosstabs
Statistical Mini-Lecture

TS10 GETTING FANCIER

Pearson Corr
Compute
Assign Missing
If
Partial Corr
T-test
More mean comparisons

TS11 MULTIVARIATE

Anova
Select If
Regression

TS12 FINALLY

Factor
Path Analysis
Discriminant
Caution and Humility

TS10 introduces and for the most part illustrates, through the student's typing the necessary commands, Pearson correlation, partial correlation, and several ways of comparing means (T-TEST, BREAKDOWN, ANOVA). Additional data transformation statements are also presented, discussed and implemented. (TS10A can be used as a short-cut to a limited review of some of the topics discussed in TS10.)

TS11 illustrates ANOVA and REGRESSION through examining questions of how sex, education and social class relate to beliefs about equal treatment for women. (The discussion of multiple regression can also be accessed via TS11A.) TS12 performs a factor analysis of some "social" and "economic" issue positions, e.g. marijuana and taxes, and it illustrates causal modeling through discussing the effects of income, social class, partisanship and ideology on general warmth or coolness toward Ford and Carter. In addition, there are two discriminant analyses in TS12--one with 1976 vote and the other with region as the dependent variable, and there are brief discussions of sampling, validity, distributional assumptions, and the availability of other analysis techniques. (Selected topics of TS12 can be accessed through TS12A.) TS12 concludes with some words of caution and humility.

I would like to illustrate some of the other principles of the competency-based instruction approach by taking you through the first module. My chief fear is that you will find it too simple, like the econometrician who called the modules condescending. But they are not intended for him. They are intended more for the older faculty member who called them the greatest thing since night baseball. Here I will outline the principles of competency-based instruction which are incorporated into the modules and give some examples of each.

1. Gradually increasing difficulty has already been mentioned--see the outline.
2. Reinforcement
   TS1's "Right on!" "You are an excellent student who will undoubtedly learn how to work the computer." "I understand your concern." "You are of course correct." "You are beautiful." "You are rapidly ending the completion of a successful lesson." The frequency of such reinforcement declines when the student's confidence and sophistication increases as he/she progresses through the modules.
3. Whereas the earlier modules are based on a stimulous-response approach with maximum possible reinforcement, the later modules emphasize a more process-oriented or generative approach to knowledge. There is an attempt to lead the student from a state of relatively passive learning to a state of relatively active inquiry.
4. Humor
   Some of the alternative answers and the responses when those answers are chosen. TS1's "A computer is" "E. a genius." "Anything that cannot think (a computer only follows instructions) cannot be a genius."
5. Wrong answers are frequently used in such a way as to define problem areas for which additional explanation is given. TS2's attempts to clarify types of files and commands and TS4's attempts to clarify the concepts of cases and variables.

6. Simplicity
   TS1's extended analogy between driving a car and running a computer. The avoidance of sophisticated definitional nuances. Continued suggestions of where to go for more in depth discussion, such as particular pages in the manual.
7. Successful completion of assignments are required before moving on. TS3's creating a data file and TS4's FREQUENCIES run.
8. Competency based branching
   TS9 branches to different places depending on how many questions the student correctly answered. There are numerous opportunities for voluntary review within the modules.
9. Illustration
   The specific suggestions for additional analyses made in TS9 through TS12.
10. Learn through doing
    TS9's FREQUENCIES, RECODing and CROSSTABS runs, TS10's variety of SPSS illustrative runs which must be performed by the student. TS11 concentrates on multivariate analysis, including ANOVA, REGRESSION and FACTOR; it also covers the SELECT IF data selection command. TS12 deals in greater depth with regression analysis, illustrates path analysis and finally DISCRIMINANT.

There is no need to go into detail about the precise topics covered by the modules. These are sufficiently covered by the outline in Table 1.

CONCLUSION

I expect the modules to be widely used. During the past summer they were used in a graduate Counselor Education course. They are presently being used in courses taught by the Secondary Education, Psychology, Geography, Economics and Biology Departments. Those courses are at SIUE. Usage growth should continue there, and I expect similar usage at other MICC institutions when the modules will shortly be made available to them. I am also interested in exploring the potentials of the modules being made available to other institutions.

Individuals attending the Conference are welcome to experiment with the TS modules. They can use the terminal or terminals which are already logged in to MICC, and there are sheets beside those terminals explaining how to access the lessons. One word of advice: do not ask for the Codebook to be printed while taking TS7. Copies of the Codebook are already available alongside the terminal(s).

Finally, I would very much appreciate comments or suggestions about improving the modules. If you find any bugs in them, please try to be specific as to which place in which module they were found.

NOTES

1. The modules have been written with financial support from most of the major schools at SIUE, specifically the Graduate School's Faculty Development Program, School of Education, Business School, and School of Science and Technology. Their support also made possible a grant from the U. S. Department of Health, Education and Welfare, and the author is of course grateful for such encouragement.

2. Keller, 1967, 1968; Sherman, 1974.

3. A good summary of such research can be found in Robin, 1976.

4. See, for example, Keller, 1968 and Hess, 1974.

5. This is similar to the generative approach discussed by Kearsley, 1977, p. 13.

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